Continuous Descent ?
And
RNAV Arrivals

From an ATC Perspective

Federal Aviation Administration

Presentation to: CDA Workshop – GA Tech
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FAA, RNAV RNP Group

Date: 18 April 2006

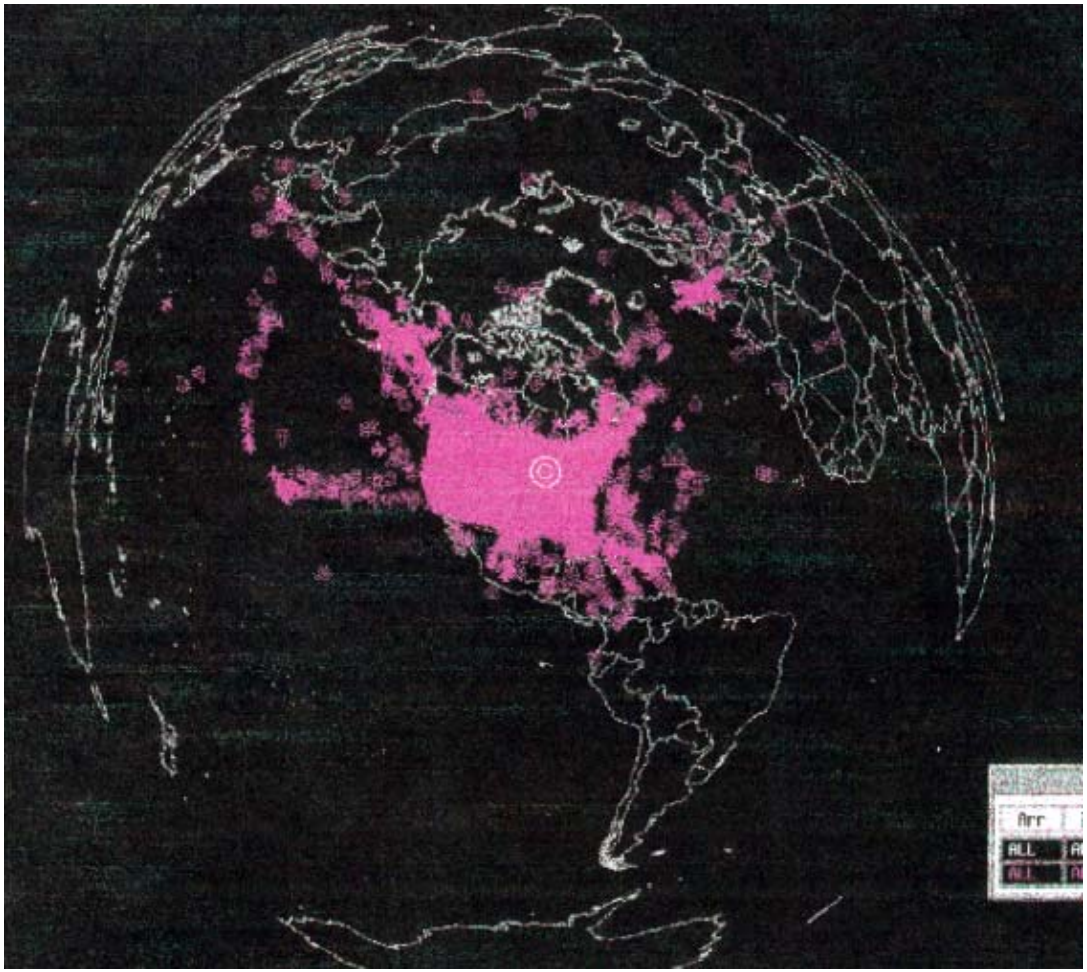
My Background

- 22 years Terminal ATC (ORDT, MBS, BOS, MKE, C90)
- Last facility - Chicago's O'Hare Tracon (C90 -13 years)
- NATCA positions held
  - National RNAV and RNP representative (3 yrs)
    - FAA HQ
  - Great Lakes Regional RNAV rep (1 yr)
  - Traffic Management Coordinator (1yr)
  - C90 Safety and Tech rep (4yrs)
  - C90 Local Vice President (2 yrs)

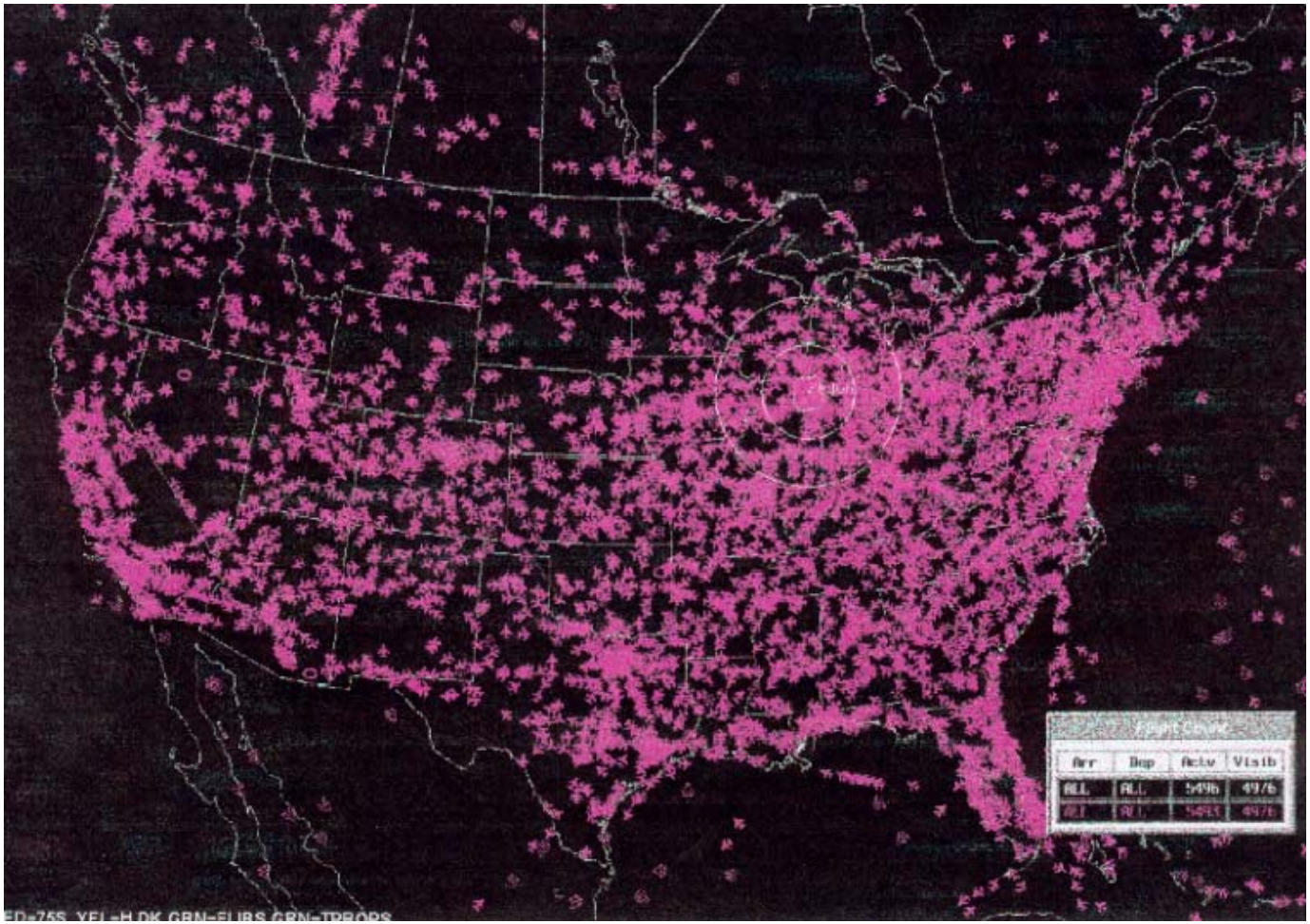
What the Air Traffic Organization (ATO) is saying...

- "CDA" is a great concept that we support!
- We also support the of optimizing of vertical profiles for terminal arrivals. We believe RNAV STARs (if developed properly) are doing this today.
- However, we need to proceed with some caution in examining "CDA"--it definitely has a future, but the applications need to be carefully studied and integrated in with other airspace modernization and redesign efforts to be successful.
- "CDA" cannot be applied in all flight environments, and we need to balance safety and operational efficiency while addressing noise, environmental and aircraft emission concerns as best possible.

Traffic Management



Traffic Management (cont'd)



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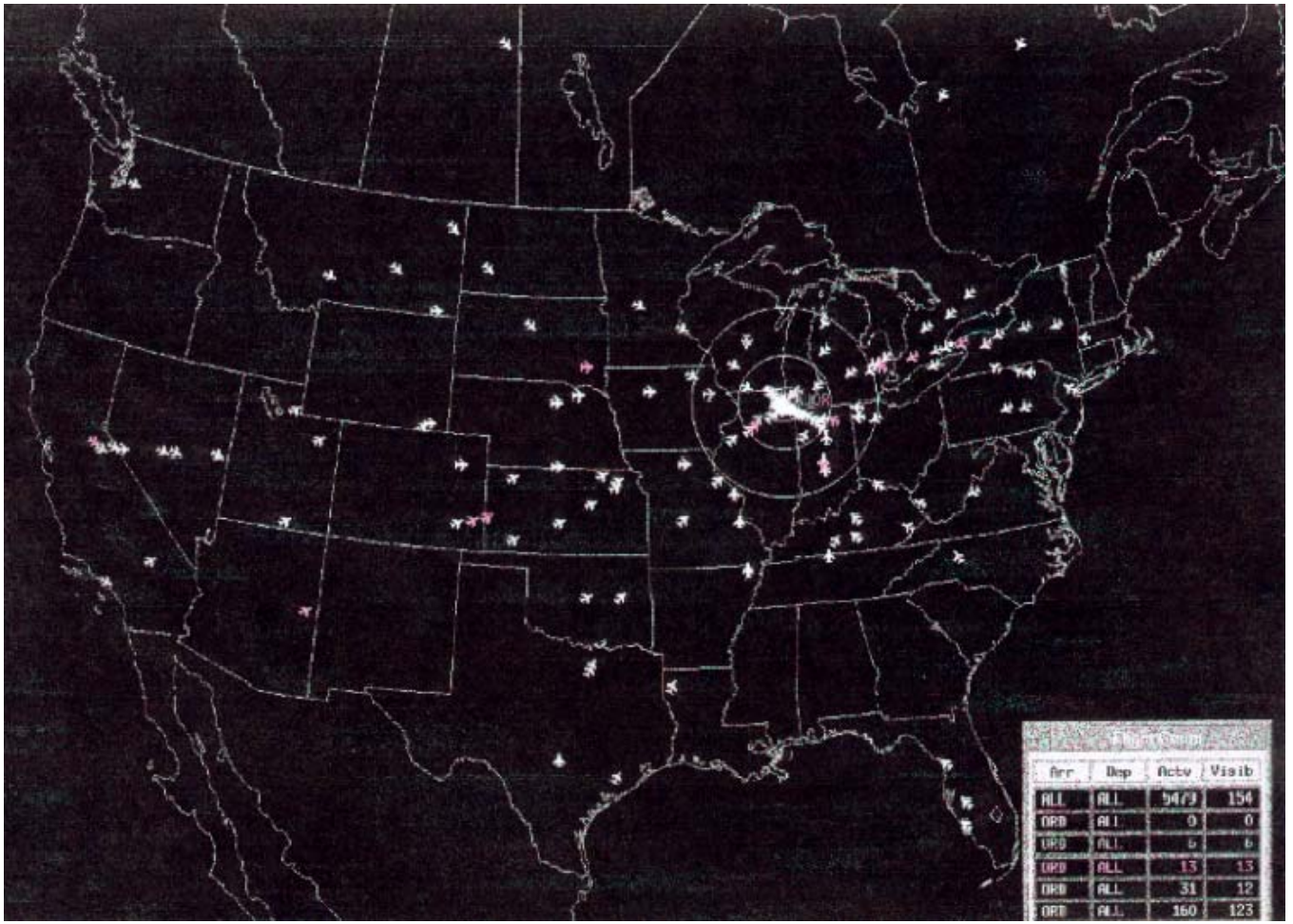


Discussion

- FAAO 7100.9d Standard Terminal Arrival (STAR)
- Descend via
- Las Vegas STARs
- ATL CDA Benefits
- Tools?

STARs

FAAO 7100.9d STAR development guidelines (excerpts)

- **1. GENERAL. Safety is a primary concern in the design of Standard Terminal Arrival (STAR) routes. A STAR will not be established solely for the purpose of noise abatement, but existing noise abatement procedures should be considered in the STAR's design.**
- **STAR procedures should be designed to standardize descents from the high-altitude en route stratum down to the terminal environment**
- **Waypoints may be assigned crossing altitudes and speeds to optimize the descent and deceleration profiles. Waypoint crossing assignment types shall be defined as "at," "at or above," "at or below," or "expect."**

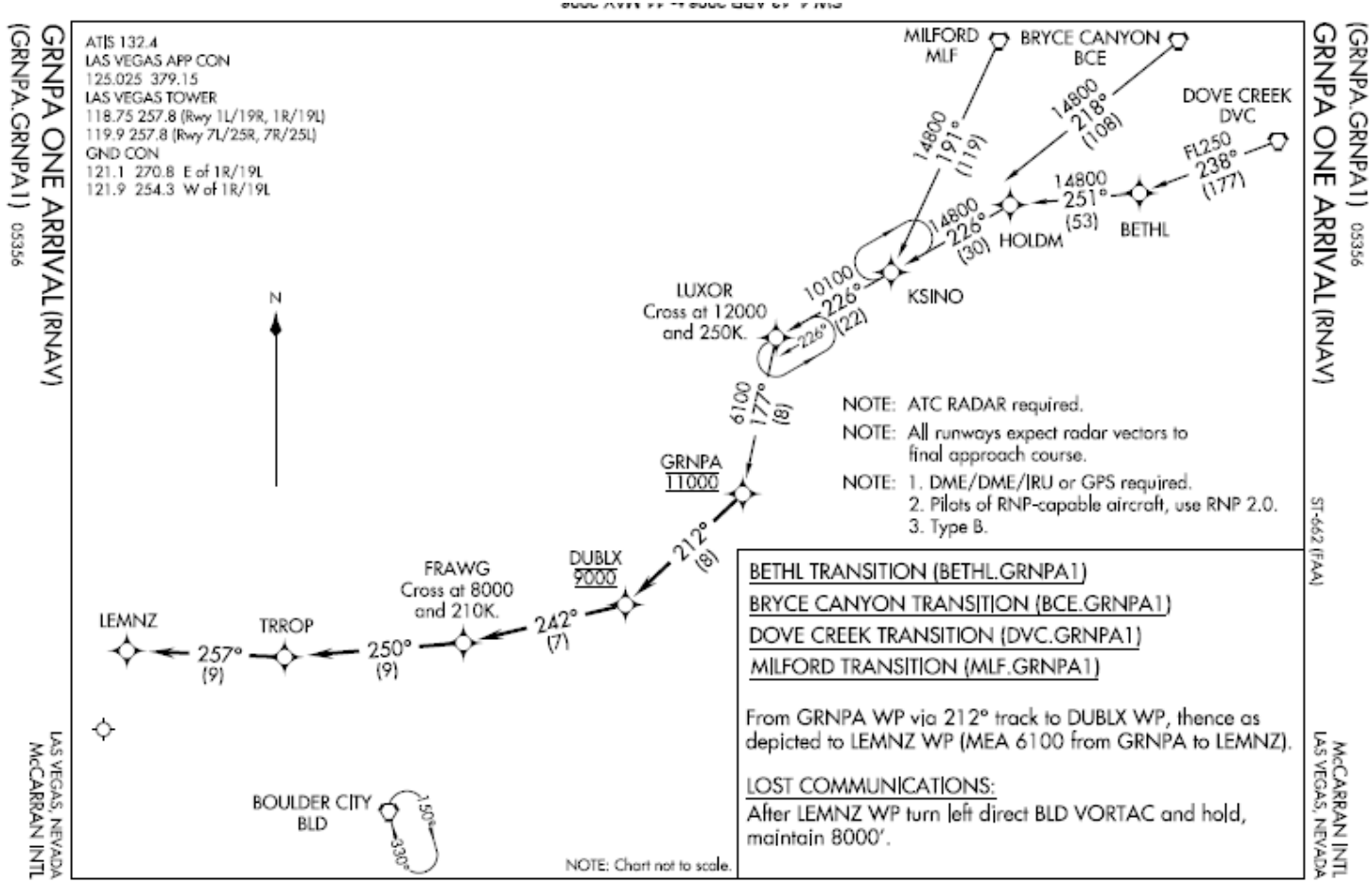
STARs (cont'd)

- **e. Descent Gradients and Deceleration Segments.**
  - **(1) STAR procedures should be designed to standardize descents from the high-altitude en route stratum down to the terminal environment.**
  - **(2) A descent gradient of 318 feet per nautical mile (FPNM) (a 3-degree vertical path angle [VPA]), should be used from the en route environment to 10,000 feet mean sea level (MSL). Below 10,000 feet MSL, the descent gradient should not exceed 330 FPNM (a 3.1-degree VPA).**
  - **(3) The STAR designer shall allow for a deceleration at any waypoint that has a speed restriction. The operational requirements of affected operators should be considered. As a general deceleration guideline, the leg distance between the waypoints should be increased at least 1 nautical mile (NM) per 10 knots (KTS) of deceleration required.**
  - ***Note–***
    - **Based on ATC SOPs, RNAV STARs may require descent gradients that exceed the 330 FPNM.**
    - **A descent gradient greater than 330 FPNM may require manual speed intervention by the pilot and deceleration segments may need to be increased to compensate.**

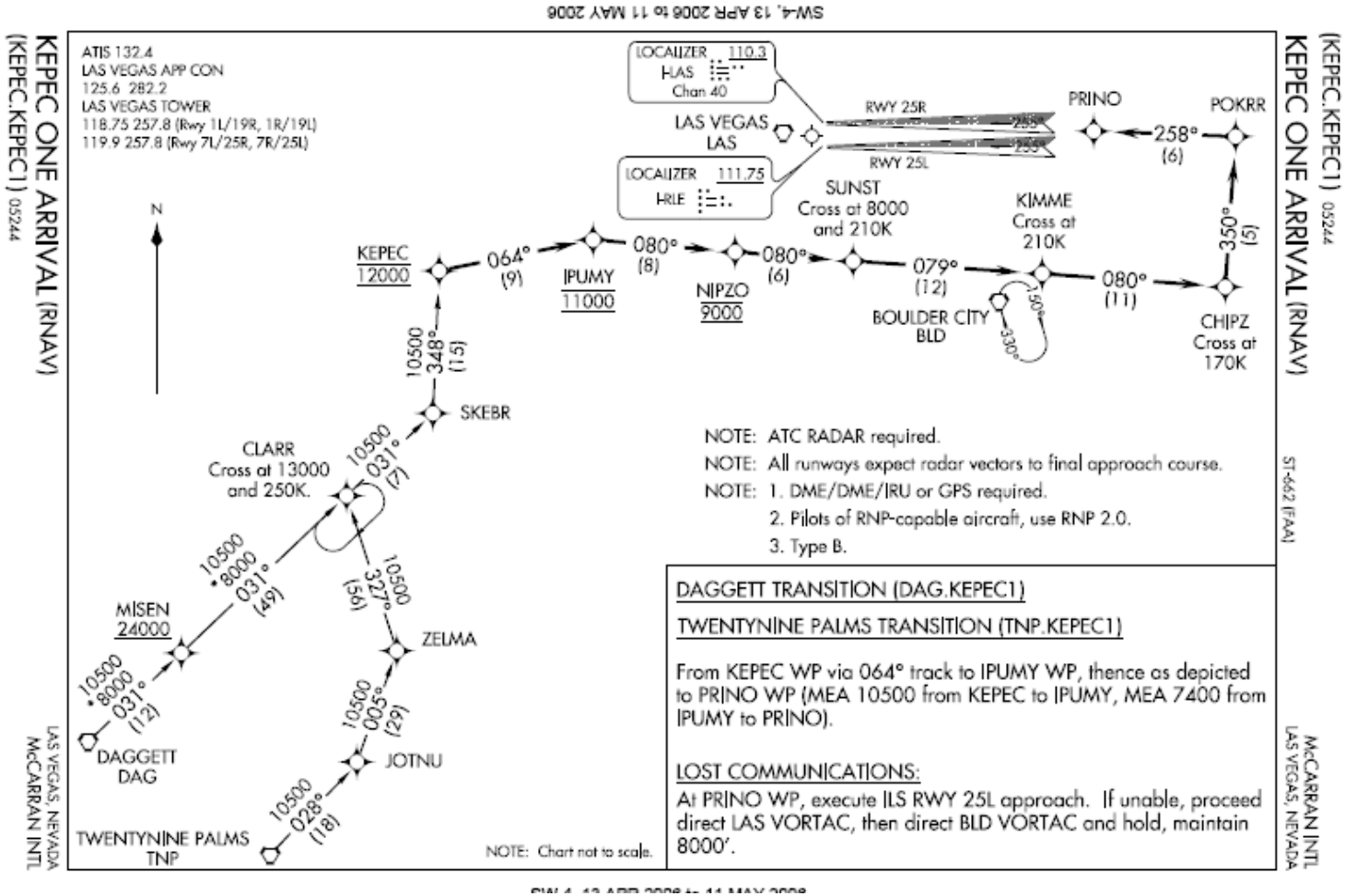
Descend Via

- ***Clearance to "descend via" authorizes <u>pilots:</u>***
- 1. *To navigate laterally and vertically at pilot's discretion, on a STAR/RNAV STAR to meet all published restrictions. ATC is responsible for obstacle clearance when issuing an offroute "descend via" clearance from a previously assigned altitude.*

GRNPA ONE (LAS)



KEPEC ONE (LAS)



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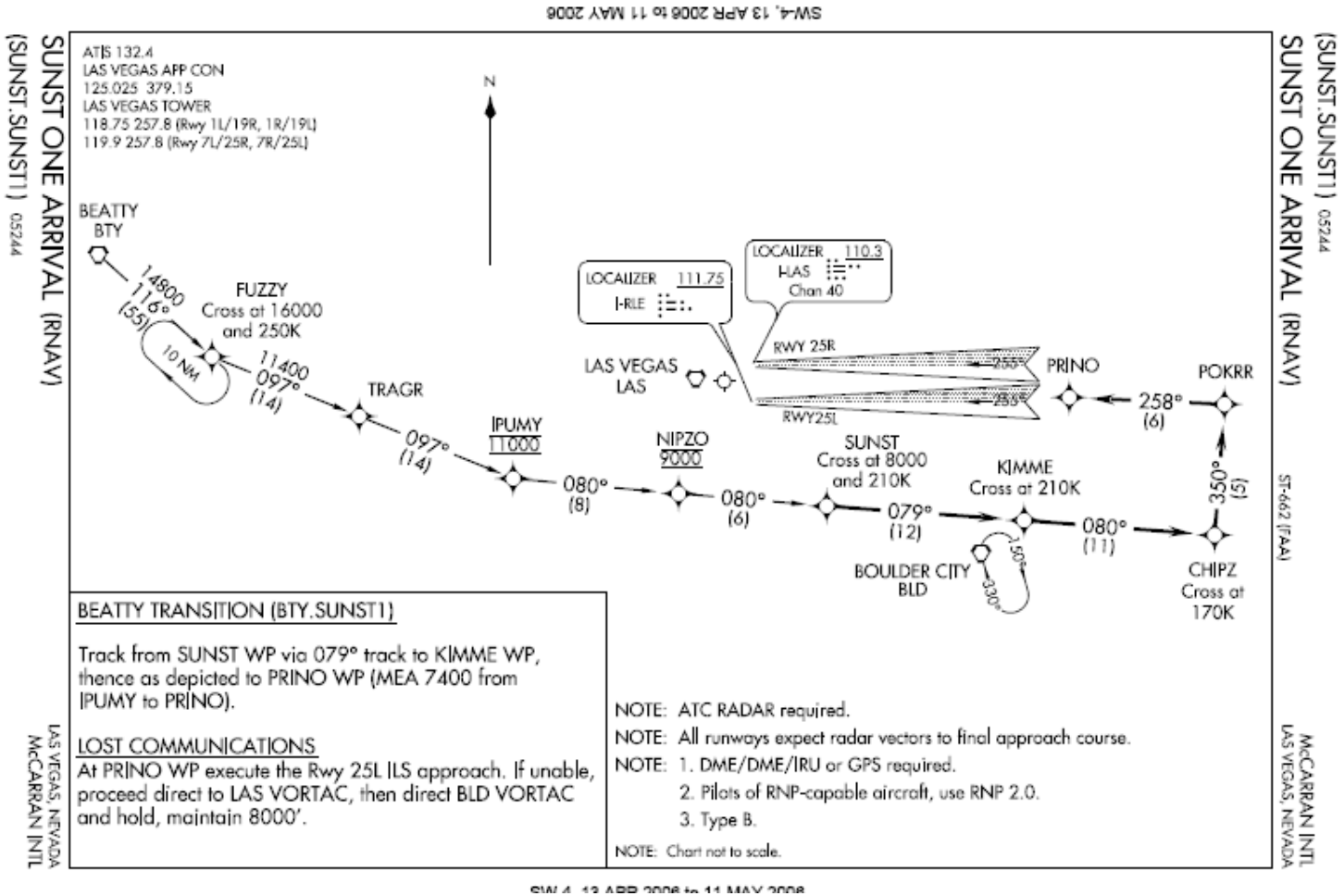

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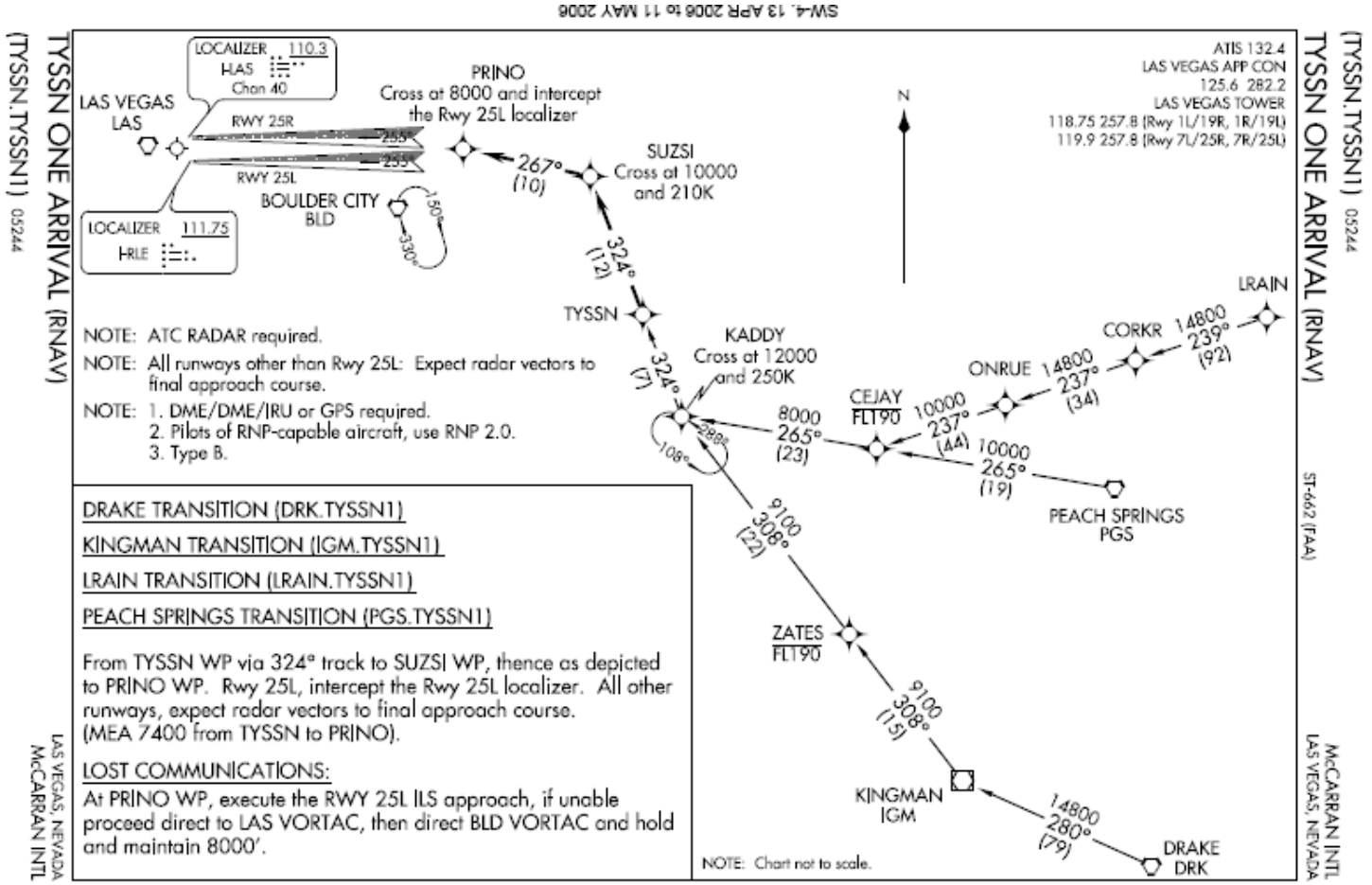


SW-4, 13 APR 2006 to 11 MAY 2006

ATL CDA Benefits Analysis

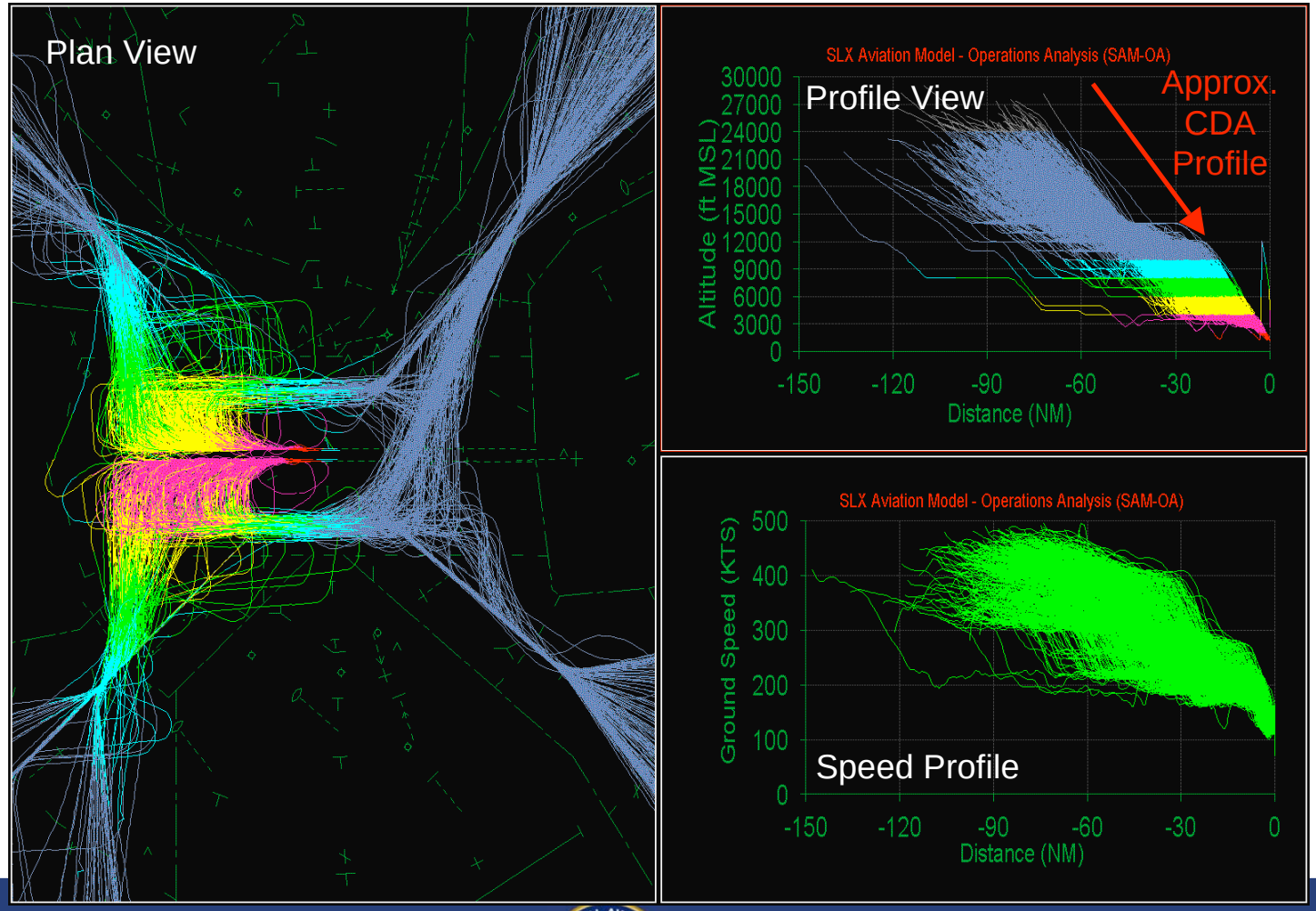
Radar Data

- **Uncompressed ARTS data of ATL arrival operations**
- **Date: 30 October 2005 (approx. 24 hrs starting at midnight local)**
- **Track Selection Criteria:**
  - **Corner post traffic**
  - **Track starting altitude >= 16000 ft (primarily jet operations)**

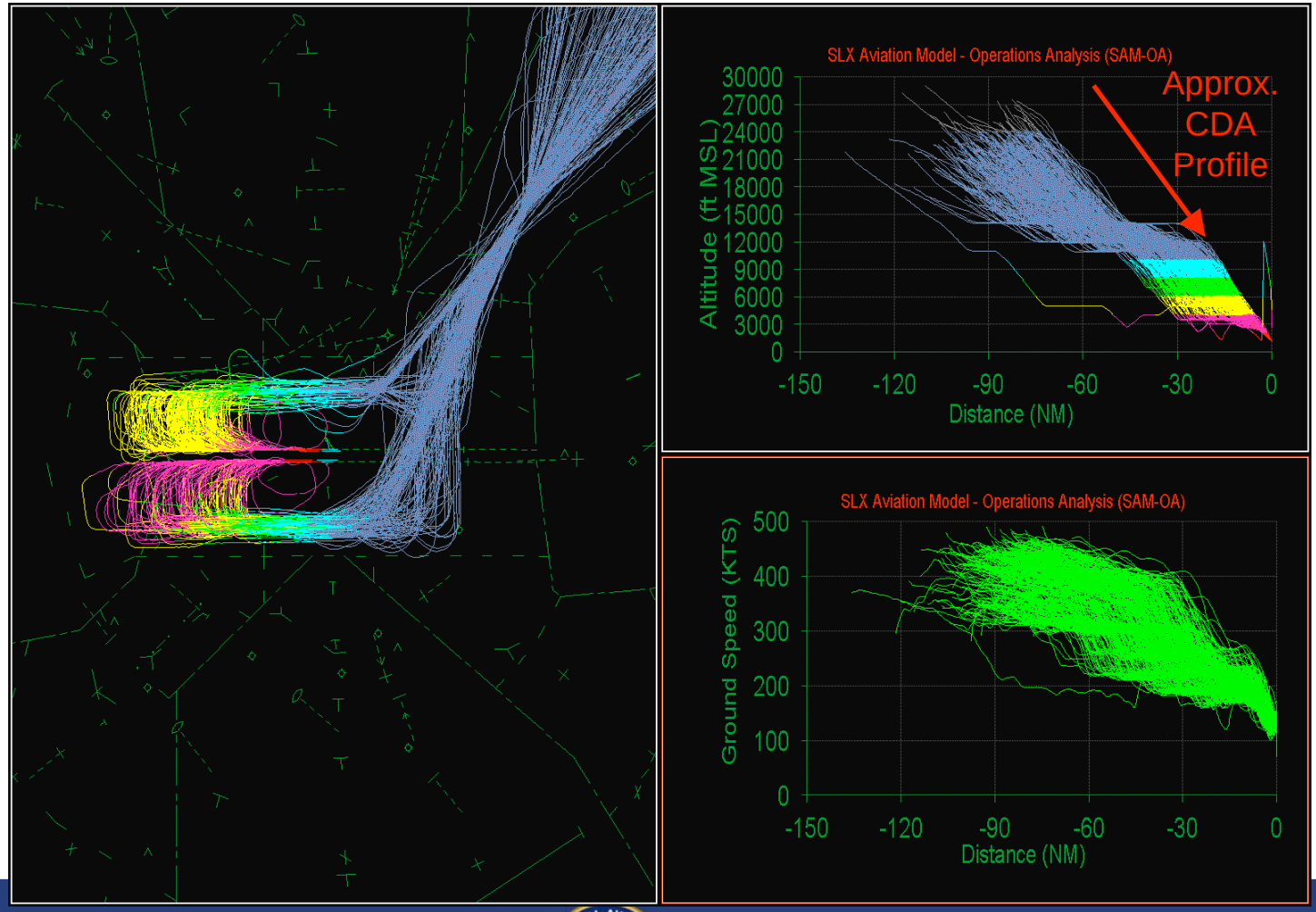
Key Assumptions

- **CDAs commence at FL300**
- **Eurocontrol's BADA fuel flow model**
- **Descent engine thrust setting: descent idle**
- **TAS = GS**
- **Aircraft configuration: clean**
- **Constant level flight speed**

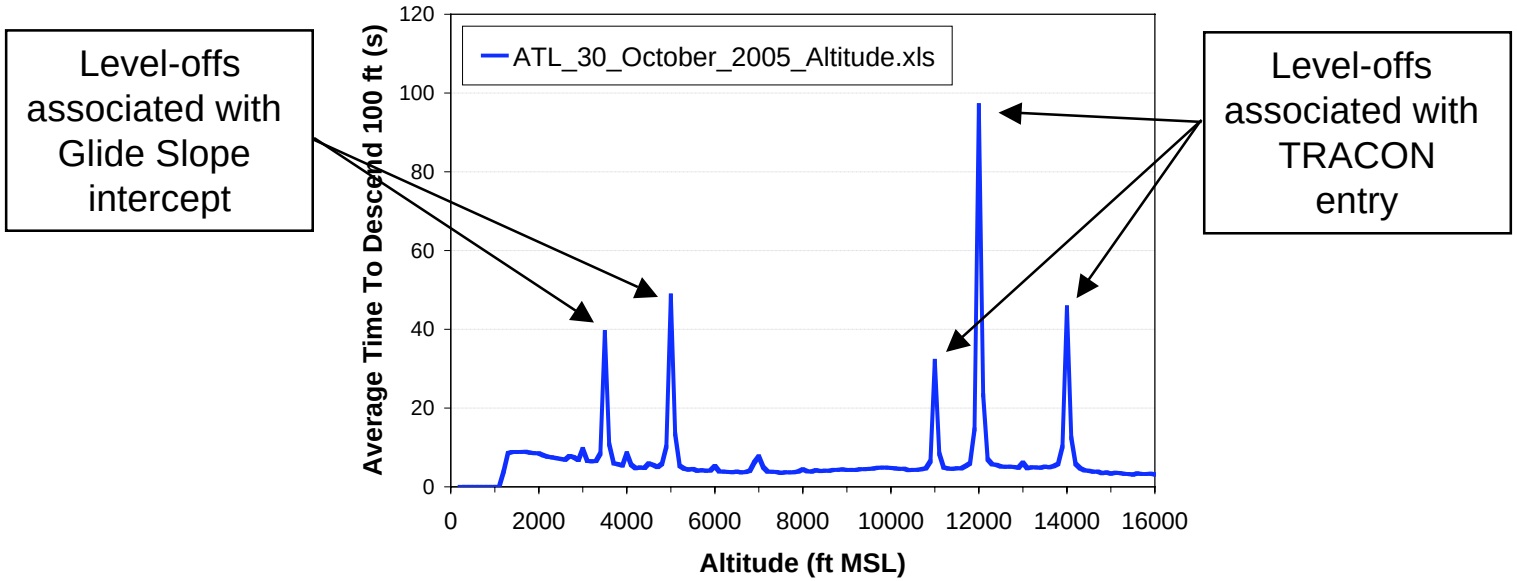
All Corner Post Arrivals
Arrival Track Visualization (945 Tracks)



NE Corner Post Arrivals
Arrival Track Visualization (360 Tracks)



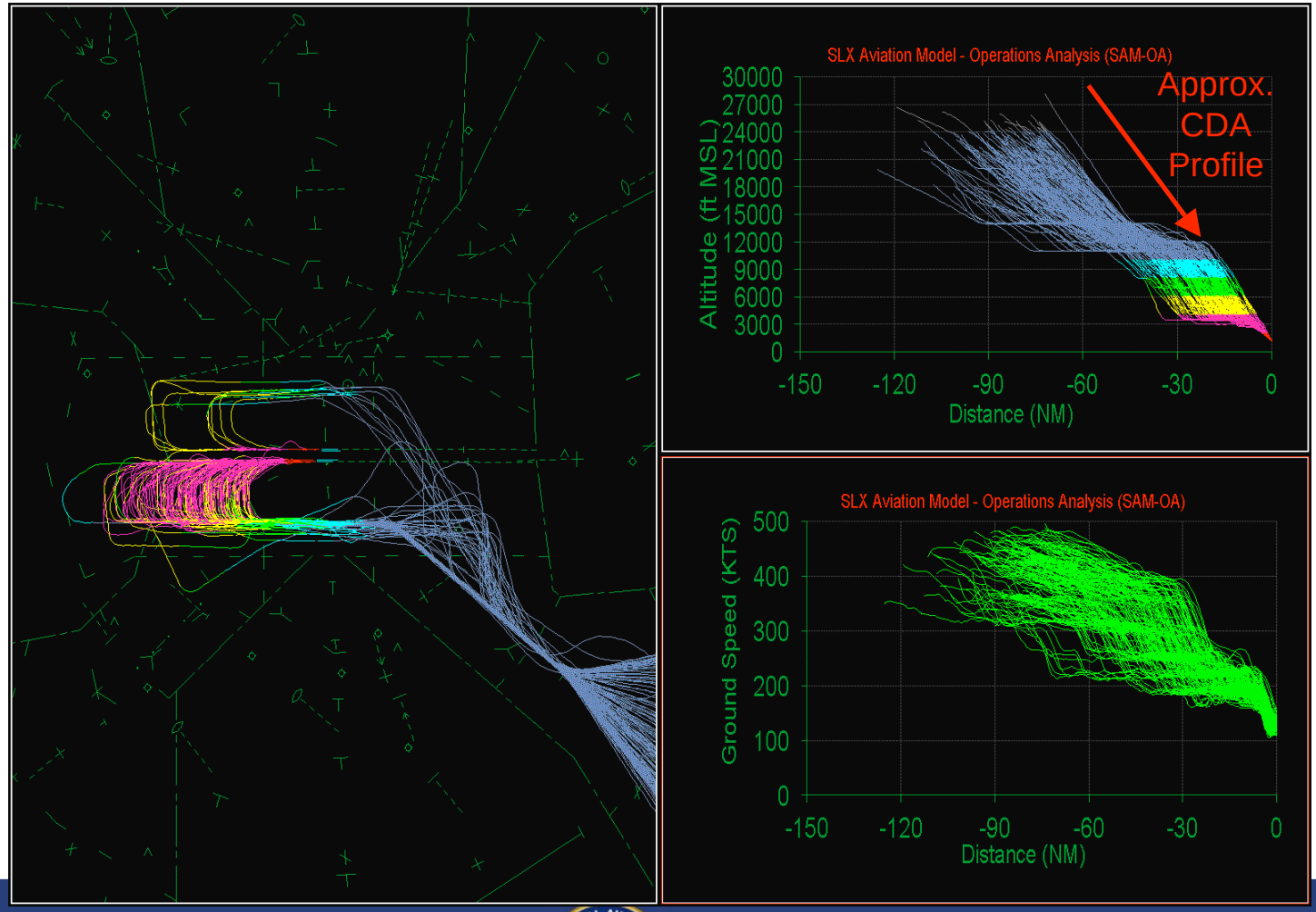
NE Corner Post Arrivals
Altitude Analysis



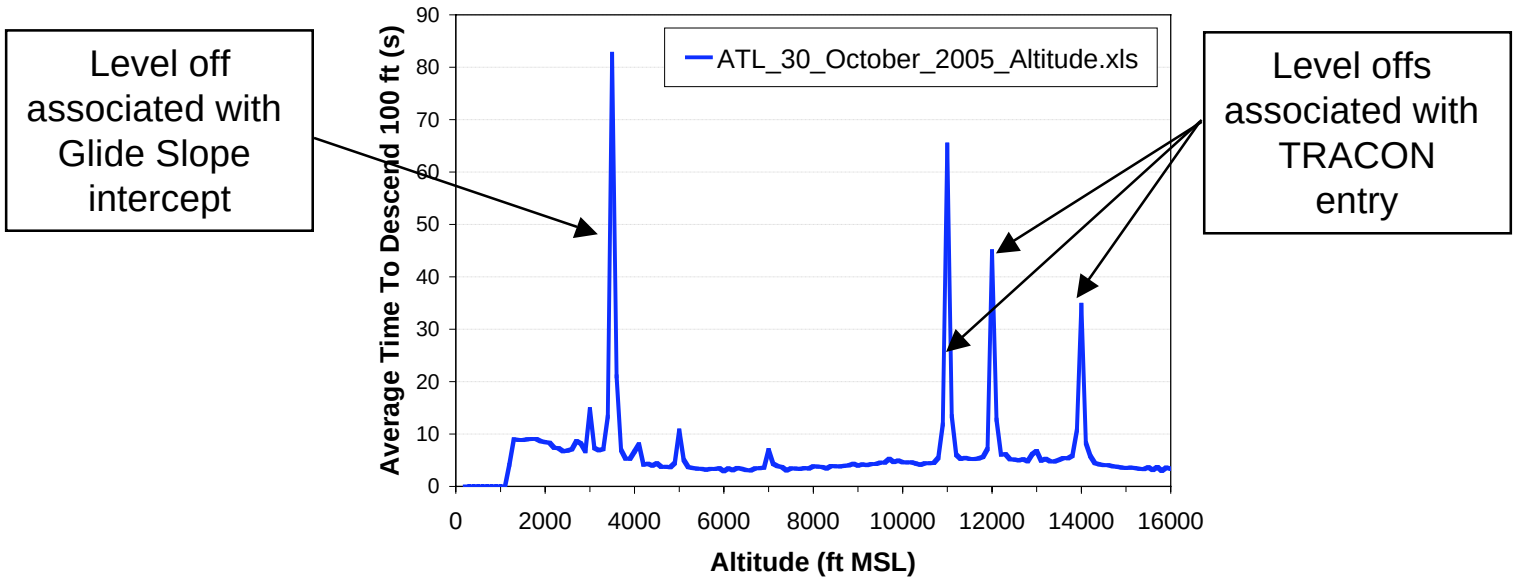
Observations

- The most significant leveling-off is observed at the following altitudes:
  - **3,500 ft, 5,000 ft (primarily Glide Slope intercept)**
  - **11,000 ft, 12,000 ft, 14,000 ft (TRACON entry)**

SE Corner Post Arrivals
Arrival Track Visualization (170 Tracks)



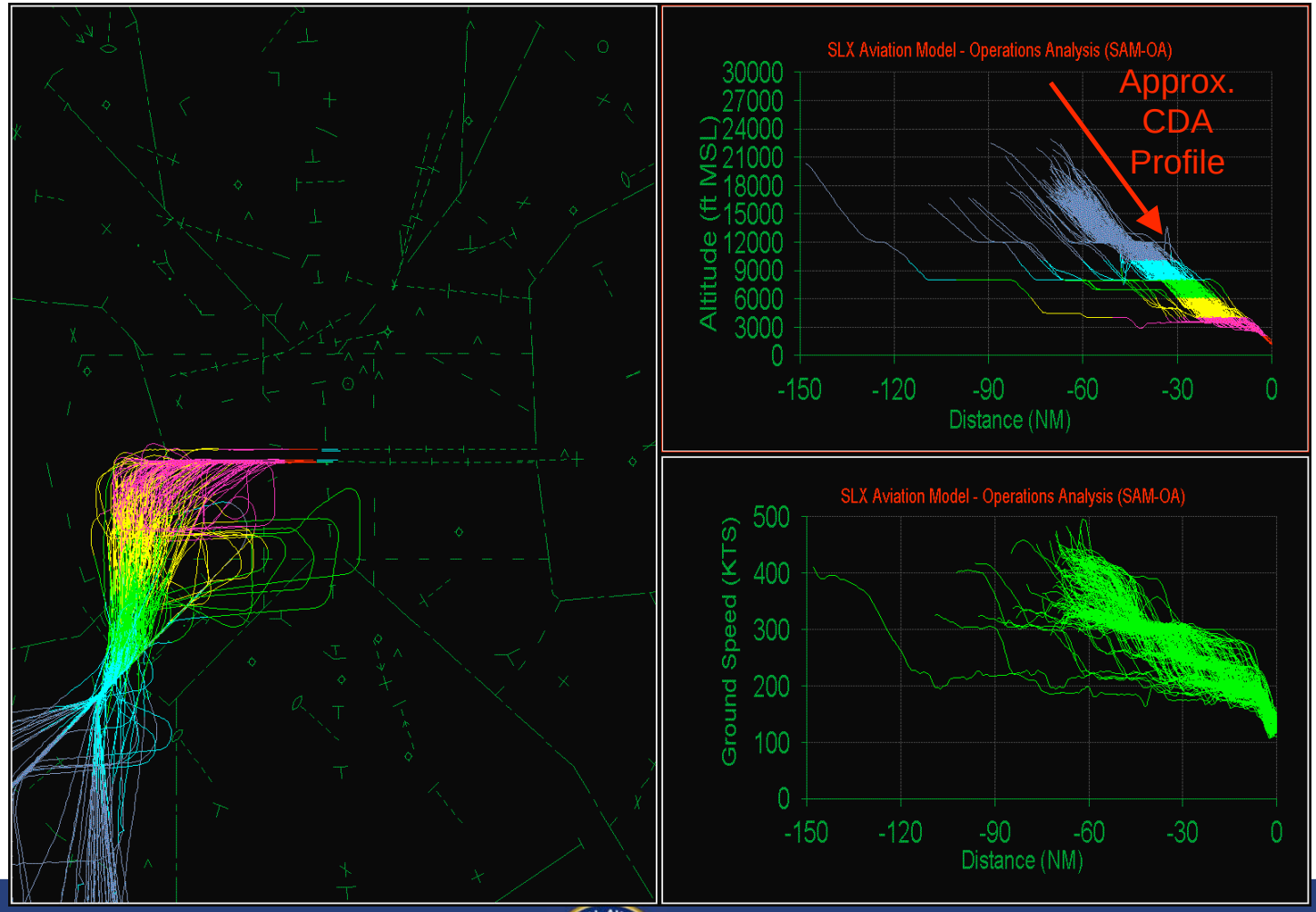
SE Corner Post Arrivals
Altitude Analysis



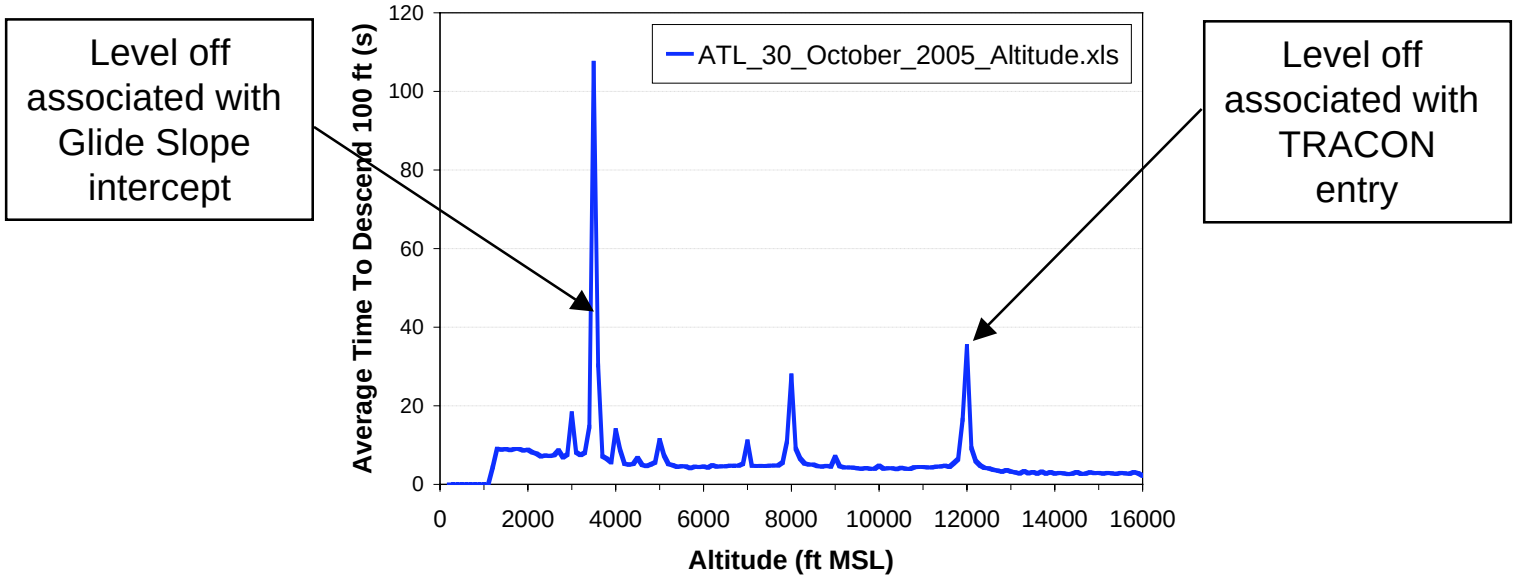
Observations

- The most significant leveling-off is observed at the following altitudes:
  - **3,500 ft (primarily Glide Slope intercept)**
  - **11,000 ft, 12,000 ft, 14,000 ft (TRACON entry)**

SW Corner Post Arrivals
Arrival Track Visualization (162 Tracks)



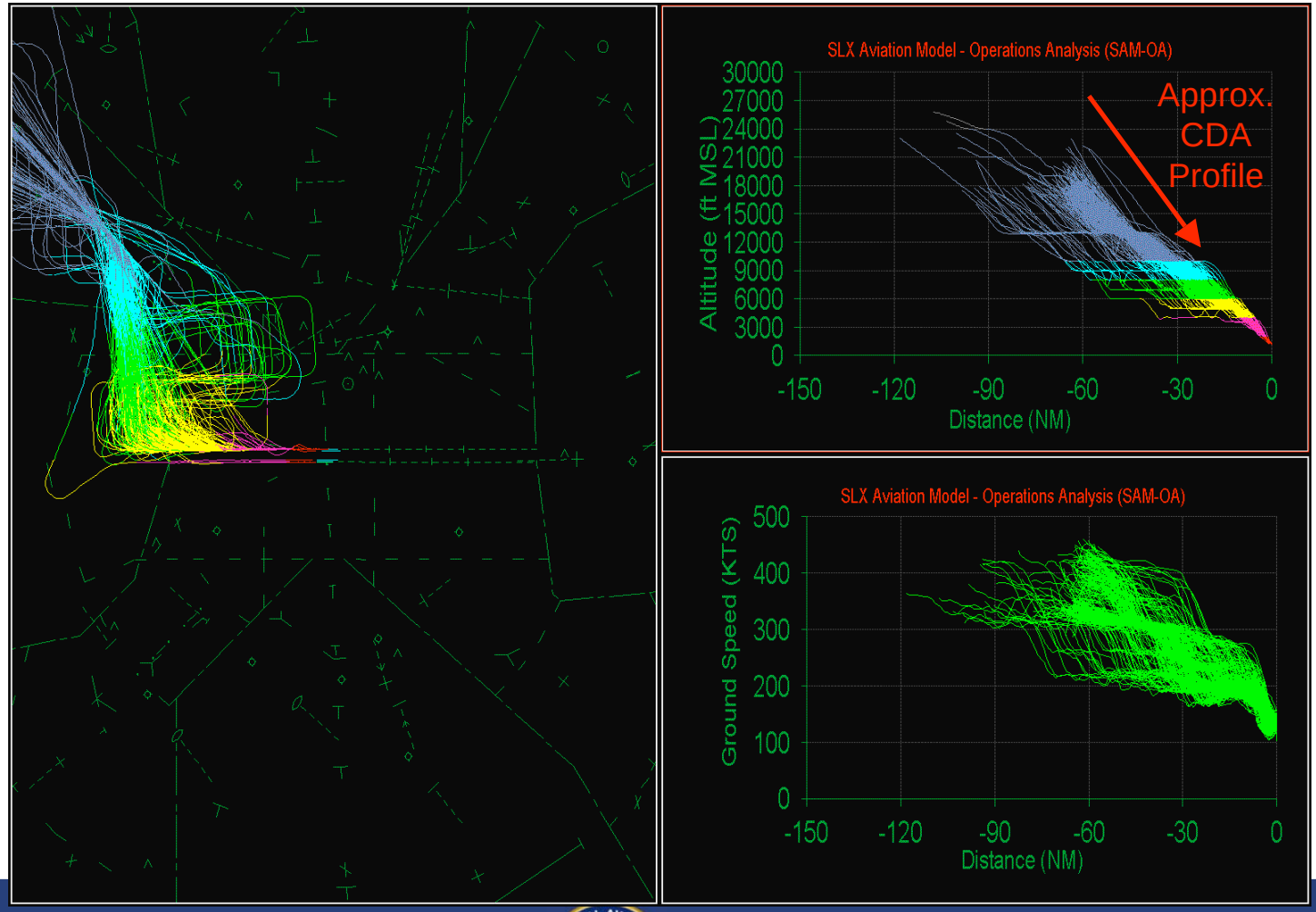
SW Corner Post Arrivals
Altitude Analysis



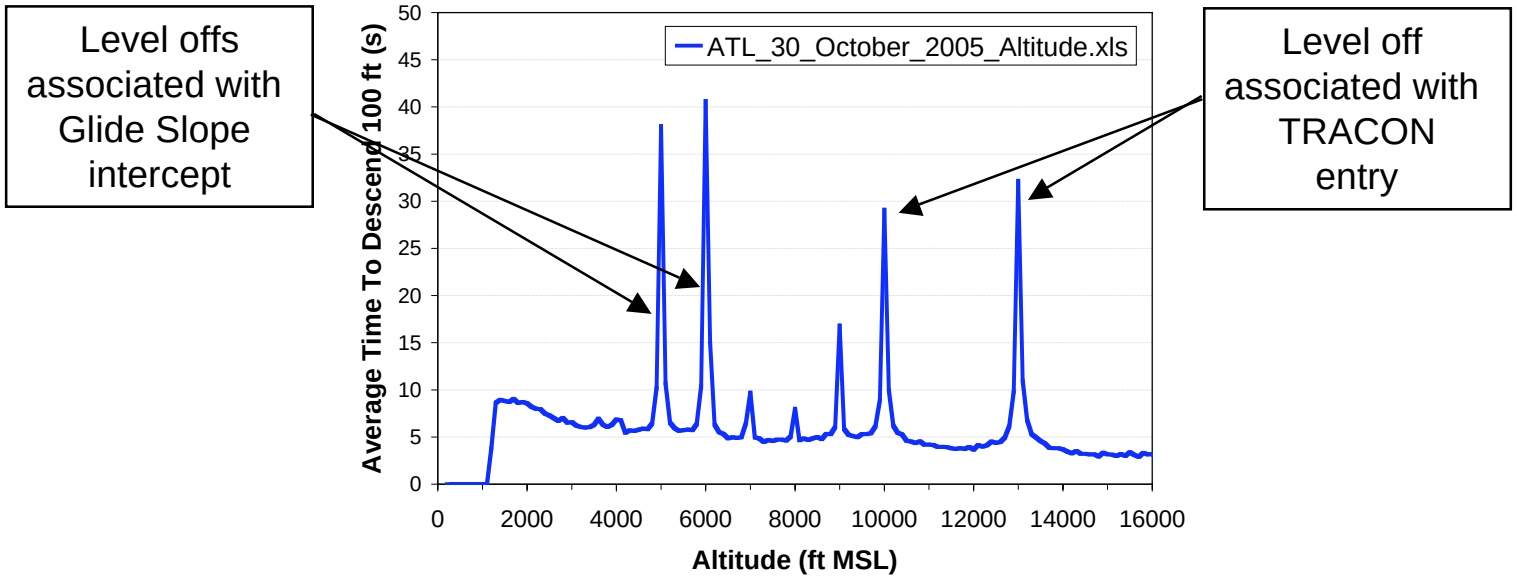
Observations

- The most significant leveling-off is observed at the following altitudes:
  - **3,500 ft (primarily Glide Slope intercept)**
  - **8,000 ft, 12,000 ft**

NW Corner Post Arrivals
Arrival Track Visualization (253 Tracks)



NW Corner Post Arrivals
Altitude Analysis



Observations

- The most significant leveling-off is observed at the following altitudes:
  - **5,000 ft, 6,000 ft (primarily Glide Slope intercept)**
  - **9,000 ft, 10,000 ft, 13,000 ft**

Results & Conclusions

Results

Corner Post	CDA Benefit Potential Based on Radar Data (30 October 2005)			
	Average Fuel Burn (gal/arrival)	Average Time (min/arrival)	Total Fuel Burn (gal)	Total Time (min)
All	**14.9**	**1.7**	**14043**	**1567**

Conclusions

- **Current operational practice generally excludes CDA operations**
- **Arrival operations often involve 3 to 5 main intermediate level-off altitudes**
- **The total distance flown in level flight at intermediate altitudes exceeds 15,000 NM per day**
- **Based on the assumption that the current operational need for intermediate level-offs could largely be eliminated, analysis indicates that arrivals whose Top-Of-Descent (TOD) point is delayed to enable Continuous Descent Approach (CDA) operations could benefit through average reductions in fuel burn of about 15 gal per arrival**

ATC “Tools” and Procedures...

- Merging and Spacing Tools - Navigation and Surveillance – ADSB, Converging Runway Display Tool (CRDA) - automation and surveillance aids for ATC that allows precise merging, and to establish and maintain arrival spacing between aircraft approaching from different arrival flows.
- Required Navigation Performance (RNP) – Will allow for more closely spaced routes and flight paths using track-to-track separation
- Traffic Management Advisor (TMA) - Help traffic management coordinators (TMCs) anticipate future demand across multiple Centers and regulate traffic flow into the TRACON.
- Required Time of Arrival (RTA) – 4D
- Others...
- Training for pilots and training

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